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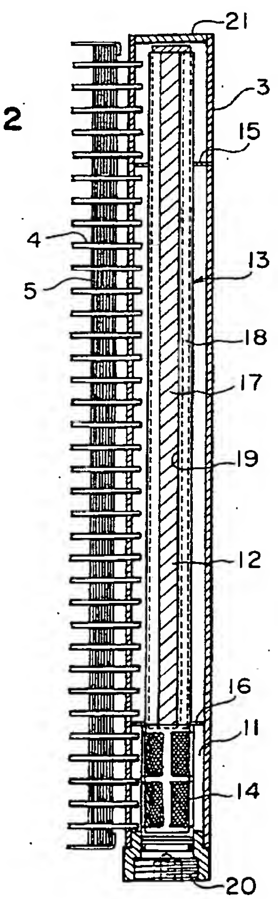
(54) **Heat exchanger**

(57) A heat exchanger includes a pair of header pipes (2, 3), a plurality of heat transfer tubes (4), and a desiccant container (18) containing a desiccant (12) inserted into a header pipe (3).

The desiccant container (18) is formed as a tubular body having an opening (19) which extends continuously in the longitudinal direction of the body over the entire length of the body. The desiccant container (18) is easily deformed in its radial direction, the desiccant (12) can be easily inserted into the container (18) and the container (18) can be easily inserted into the header pipe (3).

FIG. 2



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Description

[0001] The present invention relates to a heat exchanger used for an air conditioner for vehicles, and more specifically to a heat exchanger in which a desiccant container containing a desiccant is inserted into a header pipe, suitable for use as a heat exchanger such as a condenser equipped with a receiver.

[0002] In a heat exchanger, for example, in a condenser equipped with a receiver wherein a receiver is integrally incorporated into a condenser, a desiccant container containing a desiccant is inserted into at least one of a pair of header pipes. For example, as shown in Figs. 13 and 14, a plurality of heat transfer tubes 101 are inserted into a header pipe 102, and fins 112 are disposed on both sides of each heat transfer tube 101. A desiccant container 105 containing a desiccant 104, which is charged in bags 103 having a liquid permeability, is inserted into header pipe 102. Desiccant container 105 is supported by support members 106 and 107. The lower part of desiccant container 105 is inserted into a strainer portion 108. Lids 111 and 112 are provided on the ends of header pipe 102, and strainer portion 108 is supported by the lid 111.

[0003] In such a heat exchanger, refrigerant flowing into header pipe 102 from heat transfer tubes 101 positioned above support member 107 flows into desiccant container 105 through openings 113 provided on the desiccant container 105, and after moisture is removed from the refrigerant by desiccant 104, the refrigerant is stored temporarily in a liquid storing portion 114 formed at a portion below the support member 107 in the header pipe 102, and then flows into heat transfer tubes 101 forming a subcooling core communicated with the liquid storing portion 114.

[0004] In the above-described heat exchanger, however, since desiccant container 105 containing desiccant 104 is formed as a tubular body which is provided with a plurality of openings 113 on the outer surface and made of a resin or a metal (for example, a pure aluminum or an aluminum alloy), there may be the following problems. For example, in a case where desiccant container 105 is formed by molding such as injection molding, it may be necessary to provide a draft portion for a die, such as a tapered portion 115 shown in Fig. 15. Therefore, the inner surface of desiccant container 105 is formed such that the inner diameter is gradually decreasing toward the central portion in the longitudinal direction. As a result, the workability for inserting bags 103 enclosing desiccant 104 into the desiccant container 105 may be deteriorated remarkably. Further, in order to form tubular desiccant container 105 having openings 113 on the outer surface by injection molding, because it is necessary to employ complicated insert-die structure and sliding structure, not only the die becomes expensive but also troubles on the molding are likely to occur frequently.

[0005] In order to avoid forming of the above-described tapered draft portion and improve the workability for inserting bags 103 into desiccant container 105, a method for forming a resin or metal straight pipe and processing openings 113 thereon may be considered. In such a method, however, the cost for manufacturing desiccant container 105, and ultimately, the total cost for manufacturing the heat exchanger, may remarkably rise by increase of the processing steps.

[0006] Furthermore, in the above-described heat exchanger, in order to improve the workability for inserting desiccant container 105 into header pipe 102, the diameters of insertion holes 116 and 117 of support members 106 and 107 are set slightly greater than the outer diameter of the desiccant container 105. Namely, there inevitably exist clearances between the outer surface of desiccant container 105 and the inner surfaces of insertion holes 116 and 117. By this structure, for example, when the heat exchanger is mounted on a vehicle for use for an air conditioner, noise may occur by vibration of desiccant container 105, or foreign materials generated by abrasion ascribed to the contact between the desiccant container 105 and support members 106 and 107 may be entrapped into the circulating fluid.

[0007] Accordingly, it would be desirable to provide an improved structure for a heat exchanger which may increase the workability for inserting desiccant into a desiccant container, which may reduce the cost for manufacturing the desiccant container, and which may increase the workability for the assembly of the heat exchanger as a whole, while may achieve cost down of the heat exchanger.

[0008] Further, it would be desirable to provide an improved heat exchanger which may exhibit a high heat exchange ability, increasing the workability for the assembly of the heat exchanger as a whole.

[0009] Furthermore, it would be desirable to provide an improved structure for a heat exchanger which may prevent occurrence of noise or entering of foreign materials into circulating fluid, even if the heat exchanger is used for an air conditioner for vehicles.

[0010] The structure of a heat exchanger according to the present invention is herein provided. The heat exchanger includes a pair of header pipes, a plurality of heat transfer tubes interconnecting the pair of header pipes and extending in parallel to each other, and a desiccant container containing a desiccant inserted into at least one of the pair of header pipes. The desiccant container comprises a tubular body having an opening which extends continuously in the longitudinal direction of the tubular body over the entire length of the tubular body.

[0011] The tubular body forming the desiccant container may be formed as a C shape in cross section. The above-described desiccant container may be easily manufactured, for example, by roll forming a flat plate so that an opening extending in the longitudinal direction is formed, or by providing a notch extending continuously in the longitudinal direction to a straight pipe having

a circular, oval, track-type or polygonal cross section.

[0012] The opening of the desiccant container preferably has an angle of circumference in the cross section of the desiccant container in a range of 10 degrees to 90 degrees. If less than 10 degrees, the size of the opening becomes too small and the flow resistance into the interior of the desiccant container may become increase remarkably. On the other hand, if more than 90 degrees, the size of the opening becomes too large and the strength for retaining the desiccant by the desiccant container may decrease.

[0013] The direction of the opening of the desiccant container may be decided depending upon use of the heat exchanger, more concretely, depending upon the flow state of fluid flowing into the header pipe. For example, a structure may be employed wherein the opening is disposed so that a fluid, discharged from the heat transfer tubes into a header pipe, flows into the desiccant container through the opening after the fluid flows between an outer surface of the desiccant container and an inner surface of the header pipe. This structure is desirable for a case where, if the opening is disposed on the insertion side of heat transfer tubes, because refrigerant from the heat transfer tubes directly flows into the desiccant container through the opening, the flow of the refrigerant in the desiccant container may be disturbed, or because liquid refrigerant discharged from the opening positioned at a liquid storing portion flows directly into heat transfer tubes forming a subcooling core, bubbles may be generated and gas/liquid separation may become insufficient, and therefore, gaseous phase refrigerant is likely to enter into the subcooling core, thereby causing the efficiency of cooling to decrease. In this case, the opening is preferably disposed within a region having an angle of circumference of 270 degrees at a side opposite to a side inserted with the heat transfer tubes into the header pipe.

[0014] Alternatively, a structure may also be employed wherein the opening is disposed at a side inserted with the heat transfer tubes into the header pipe. This structure is desirable for a case where, if the opening is disposed on the side opposite to the tube insertion side, because refrigerant from the heat transfer tubes once collide with the outer surface of the desiccant container and thereafter flows in a space between the outer surface of the desiccant container and the inner surface of the header pipe, during this flow there may occur a relatively great pressure loss, or even in the liquid storing portion, because the refrigerant flows into the tubes forming the subcooling core after the liquid refrigerant discharged through the opening flows in a space between the outer surface of the desiccant container and the inner surface of the header pipe, similarly there may occur a relatively great pressure loss. In this case, the opening is preferably disposed within a region having an angle of circumference of 180 degrees at the side inserted with the heat transfer tubes into the header pipe.

[0015] Further, in the present invention, the following structure may be employed in order to prevent noise from generating or to prevent foreign materials from entering into heat-exchange fluid.

[0016] Namely, a structure may be employed wherein an annular support member having an insertion hole inserted with the desiccant container is provided in the header pipe, and the desiccant container is fixed to an inner circumferential surface of the insertion hole of the support member.

[0017] In this structure, the desiccant container may be fixed to the support member by brazing. The heat exchanger according to the present invention is usually manufactured by making a temporary assembly condition of respective parts and brazing all the parts in a furnace at a time. Therefore, the brazing between the desiccant container and the support member can also be performed in the furnace together with the brazing of other parts. Further, after the desiccant container is inserted into the header pipe, the desiccant container may be fixed to the support member by enlarging the diameter of the desiccant container.

[0018] A notch may be provided to the annular support member on its periphery. The notch is formed, for example, as a sector. The pressure loss of the fluid in the header pipe may be reduced by providing such a notch.

[0019] Further, a slit extending in the circumferential direction may be provided to the header pipe for inserting the support member into the header pipe. By providing such a slit, the support member can be inserted into the header pipe easily and at a high positional accuracy.

[0020] The tubular body forming the desiccant container may be made of a resin or a metal such as a pure aluminum or an aluminum alloy.

[0021] The heat exchanger according to the present invention may be applied broadly to any type of heat exchanger in which a desiccant container containing desiccant is inserted into a header pipe. Particularly, the structure of the heat exchanger according to the present invention is suitable to a subcooling-type condenser wherein a liquid storing portion is formed in a lower portion of a header pipe and the condenser has a refrigerant condensation core for condensing refrigerant and a subcooling core for supercooling refrigerant condensed by the refrigerant condensation core.

[0022] In the heat exchanger according to the present invention, the desiccant container comprises a tubular body having an opening which extends continuously in the longitudinal direction of the tubular body over the entire length of the tubular body.

[0023] Such a tubular body may be easily manufactured at a single process, for example, by roll forming a single flat plate so as to form a gap between both ends thereof, or by providing a notch extending continuously in the longitudinal direction to a straight pipe on the market, or by injection molding or extrusion molding. Further, since the opening can be widened toward both

sides by elastic deformation of the tubular body when desiccant is inserted into the tubular body, the workability of the insertion of the desiccant may be increased.

[0024] Moreover, after the insertion of the desiccant, the desiccant may be securely retained in the tubular body by the elastic recovery of the tubular body.

[0025] Further, by providing the above-described opening, since the diameter of the desiccant container can be decreased by the elastic deformation of the desiccant container as compared of the diameter at its free condition when the desiccant container is inserted into the header pipe, the desiccant container may be inserted into and through the support member very easily. After the desiccant container is inserted into the header pipe, because the desiccant container is returned to be in the initial free condition in diameter before the insertion by its elastic recovering force, if the diameter of the desiccant container at its free condition is set to a diameter equal to or slightly larger than the diameter of the insertion hole of the support member, the outer surface of the desiccant container may be naturally brought into contact with the inner circumferential surface of the insertion hole of the support member, and the desiccant container may be fixed easily and securely at a proper position in the header pipe. Moreover, when the desiccant container is connected to the support member at this state by, for example, brazing, the desiccant container may be fixed at a proper position with a high accuracy relative to the support member.

[0026] Thus, in the heat exchanger according to the present invention, the desiccant container may be manufactured at a single process very easily and with a low cost, the insertion of the desiccant into the desiccant container and the insertion of the desiccant container into the support member may be both facilitated, and therefore, the workability for assembly of the whole of the heat exchanger may be increased and the cost for the manufacture of the heat exchanger may be reduced.

[0027] Further, when the opening of the desiccant container is disposed within a region at a side opposite to the tube insertion side, because the refrigerant discharged from the tubes may be rectified and the refrigerant may flow into the desiccant container through the opening at a stable flow condition, the disturbance of the flow and the liquid level in the desiccant container may be prevented. Therefore, the gas/liquid separation in the desiccant container may be well performed, gaseous-phase refrigerant may be prevented from entering into the subcooling core, and the cooling ability may be increased.

[0028] Alternatively, when the opening of the desiccant container is disposed within a region at the tube insertion side, because the pressure loss ascribed to the fluid passing through the opening of the desiccant container may be greatly decreased and the total pressure loss in the heat exchanger may be greatly decreased, the heat exchange performance may be improved.

[0029] Furthermore, when the structure for fixing the desiccant container to the inner circumferential surface of the support member is employed, because the desiccant container may be fixed to the support member securely and easily at a proper position, the occurrence of the vibration of the desiccant container may be prevented even if a vibration force is applied to the heat exchanger. Therefore, occurrence of noise and generation of foreign materials may be appropriately prevented.

[0030] Further objects, features, and advantages of the present invention will be understood from the following detailed description of the preferred embodiments of the present invention with reference to the accompanying figures.

[0031] Embodiments of the invention are now described with reference to the accompanying figures, which are given by way of example only, and are not intended to limit the present invention.

Fig. 1 is an elevational view of a heat exchanger according to a first embodiment of the present invention.

Fig. 2 is an enlarged, vertical sectional view of a first header pipe of the heat exchanger depicted in Fig. 1.

Fig. 3 is an enlarged, cross-sectional view of the first header pipe of the heat exchanger depicted in Fig. 1.

Fig. 4 is a perspective view of a desiccant container of the heat exchanger depicted in Fig. 1.

Fig. 5 is a cross-sectional view of a header pipe of a heat exchanger according to a second embodiment of the present invention.

Fig. 6 is a cross-sectional view of a header pipe of a heat exchanger according to a modification of the second embodiment depicted in Fig. 5.

Fig. 7 is a cross-sectional view of a header pipe of a heat exchanger according to a third embodiment of the present invention.

Fig. 8 is a cross-sectional view of a header pipe of a heat exchanger according to a fourth embodiment of the present invention.

Fig. 9 is a plan view of a support member depicted in Fig. 8.

Fig. 10 is a perspective view of a desiccant container of the heat exchanger depicted in Fig. 8.

Fig. 11 is a partial perspective view of a header pipe of the heat exchanger depicted in Fig. 8.

Fig. 12 is a partial, vertical sectional view of the header pipe depicted in Fig. 11.

Fig. 13 is a vertical sectional view of a header pipe of a conventional heat exchanger into which a desiccant container is inserted.

Fig. 14 is a cross-sectional view of the header pipe depicted in Fig. 13.

Fig. 15 is a schematic vertical sectional view of the desiccant container of the heat exchanger depicted in Fig. 13.

Fig. 16 is a partial, cross-sectional view of a conventional heat exchanger showing a supporting state of a desiccant container by a support member.

[0032] Referring to Figs. 1 to 4, a heat exchanger according to a first embodiment of the present invention is provided. This embodiment shows a case where the present invention is applied to a condenser equipped with a receiver, in particular, to a subcooling-type condenser.

[0033] In Fig. 1, subcooling-type condenser 1 comprises a second header pipe 2 and a first header pipe 3 extending in a vertical direction and in parallel to each other, and a plurality of heat transfer tubes 4 fluidly interconnecting the pair of header pipes 2 and 3 and extending in parallel to each other. Corrugated fins 5 are interposed between the respective adjacent heat transfer tubes 4 and outside of the outermost heat transfer tubes 4 as outermost fins. An inlet pipe 6 for refrigerant is provided on the upper portion of second header pipe 2 and an outlet pipe 7 for refrigerant is provided on the lower portion of the second header pipe 2, respectively.

[0034] A partition 8 is provided in second header pipe 2, and the inside of the second header pipe 2 is divided into an upper space and a lower space by the partition 8. By this partition 8, the heat-exchange area of the heat exchanger, in which the plurality of heat transfer tubes 4 are arranged, is parted into a refrigerant condensation core 9 for condensing refrigerant introduced into the condenser 1 and a subcooling core 10 for supercooling the refrigerant condensed by the refrigerant condensation core 9. Namely, the whole of the core of condenser 1 is parted into refrigerant condensation core 9 and subcooling core 10 by providing partition 8 in second header pipe 2 which is integrally formed. In this embodiment, the refrigerant path of refrigerant condensation core 9, which is formed by a plurality of parallel heat transfer tubes 4 in the region of refrigerant condensation core 9, is formed as a single-direction path. Therefore, the refrigerant introduced from inlet pipe 6 into second header pipe 2 passes through respective heat transfer tubes 4 of refrigerant condensation core 9 at a state of a single-direction passage, and then flows into first header pipe 3. After the refrigerant flows in first header pipe 3 down to the entrance portion of subcooling core 10, the refrigerant enters into respective heat transfer tubes 4 of the subcooling core 10, passes through the heat transfer tubes, and then flows out from outlet pipe 7. However, the portion of refrigerant condensation core 9 may be formed as a form having two or more refrigerant passage directions.

[0035] Further, in this embodiment, a rate of area occupancy of the portion of subcooling core 10 relative to the entire area of the core portion of subcooling-type condenser 1 is set at about 10%. According to an experiment with the present invention, this occupancy rate preferably is within a range of about 5% to about 12%. By setting the occupancy rate within this range, an optimum degree of supercooling may be realized while suppressing increases in pressure on a high pressure side, that are caused by space limitations due to the installation of the condenser in an engine compartment of a vehicle. In particular, such pressure increases are suppressed by a structure for subcooling within a limited condenser size. Further, an optimum degree of supercooling may be realized while avoiding increases in fuel consumption of the vehicle accompanying increases on the high pressure side.

[0036] Further, in this embodiment, in first header pipe 3, at least the header portion corresponding to the entrance portion of subcooling core 10 is formed as liquid refrigerant storage portion 11 (liquid storing portion). After moisture of the refrigerant sent from refrigerant condensation core 9 is removed, the refrigerant is temporarily stored in this liquid refrigerant storage portion 11, and introduced therefrom into respective heat transfer tubes 4 of subcooling core 10.

[0037] A desiccant unit 13 is inserted into first header pipe 3, also as shown in Figs. 2 to 4. Desiccant unit 13 comprises bags 17 charged with desiccant 12 and having a liquid permeability, and a desiccant container 18 containing these bags.

[0038] In this embodiment, desiccant container 18 is formed as a tubular body having an opening 19 which extends continuously in the longitudinal direction over the entire length of the body. Desiccant container 18 with opening 19 has a C-shaped cross section. Further, in this embodiment, opening 19 of desiccant container 18 is disposed at a circumferential position in the cross section of desiccant container 18 where refrigerant, discharged from heat transfer tubes 4 forming refrigerant condensation core 9 into header pipe 3, flows into desiccant container 18 through opening 19 after the refrigerant flows between the outer surface of desiccant container 18 and the inner surface of header pipe 3. In other words, opening 19 is disposed at a position where refrigerant discharged from heat transfer tubes 4 does not flows directly into the inside of desiccant container 18. Because refrigerant discharged from heat transfer tubes 4 does not flows directly into desiccant container 18, disturbance of the flow and the liquid level in desiccant container 18 may be prevented, and stable gas/liquid separation may be ensured. As shown in Fig. 3, size Cr of opening 19 is set within a range of 10 degrees to 90 degrees in angle of circumference in the cross section of desiccant container 18.

[0039] Desiccant container 18 may be made of a resin or a metal. Desiccant container 18 having opening 19 extending continuously in the longitudinal direction may be manufactured easily at a single process, for example, by roll forming a single flat plate so as to form a gap (an opening) between both ends thereof, or by providing a notch extending continuously in the longitudinal direction to a straight pipe on the market, or by injection molding or extrusion molding.

[0040] Desiccant container 18 is supported by annu-

lar support members 15 and 16. The lower portion of desiccant container 18 is inserted into strainer 14 which traps foreign materials entering in refrigerant. Strainer 14 is supported by a lid 20 screwed into an end of header pipe 3. On the other end of header pipe 3, lid 21 is brazed.

[0041] In this embodiment, since desiccant container 18 is formed as a tubular body having opening 19 continuously extending in the longitudinal direction, when desiccant 12 (or bags 17 containing desiccant 12) is inserted into desiccant container 18, by enlarging opening 19 toward both sides and elastically deforming desiccant container 18, desiccant 12 may be easily inserted into and contained in desiccant container 18, thereby increasing the workability of insertion. Further, the form of desiccant container 18 is returned to its original size by its elastic recovery property after the insertion, desiccant 12 may be securely retained in desiccant container 18 inserted into header pipe 3.

[0042] Further, because the opening size Cr of opening 19 is set within a range of 10 degrees to 90 degrees in angle of circumference in the cross section of desiccant container 18, an excessive increase of flow resistance of refrigerant introduced into desiccant container 18 may be prevented, while a sufficient retaining strength for desiccant 12 may be ensured.

[0043] Fig. 5 depicts the cross section of a header pipe portion of a heat exchanger according to a second embodiment of the present invention. In this embodiment, opening 19 of desiccant container 18 is directed in the direction from which refrigerant, discharged from heat transfer tubes 4 forming refrigerant condensation core 9 into header pipe 3, flows into desiccant container 18 through opening 19 after the refrigerant flows between the outer surface of desiccant container 18 and the inner surface of header pipe 3, and particularly, opening 19 is disposed at a side opposite to the insertion side of heat transfer tubes 4. However, opening 19 may be disposed at another circumferential position, as shown in a modification of the above-described embodiment as depicted in Fig. 6. Namely, opening 19 may be disposed within a region having an angle of circumference of 270 degrees at a side opposite to a side inserted with heat transfer tubes 4 into header pipe 3. The embodiment shown in Fig. 6 is substantially same as the embodiment shown in Fig. 3. Further, also in these embodiments, the size Cr of opening 19 preferably is set within a range of 10 degrees to 90 degrees in angle of circumference in the cross section of desiccant container 18.

[0044] In these embodiments, refrigerant sent from heat transfer tubes 4 collides the outer surface of desiccant container 18, flows between the outer surface of desiccant container 18 and the inner surface of header pipe 3, and then enters into desiccant container 18 through opening 19, as shown by the arrows in Figs. 5 and 6. The refrigerant flows into desiccant container 18 at a stable flow condition while being rectified, and therefore, disturbance of the flow and the liquid level of refrigerant in desiccant container 18 may be prevented, the gas/liquid separation effect in the desiccant container 18 may be increased, and gaseous-phase refrigerant may be prevented from entering into subcooling core 10. Further, in liquid storing portion 11, because liquid refrigerant discharged through opening 19 does not enter directly into heat transfer tubes 4 forming subcooling core 10, gaseous-phase refrigerant may be further prevented from entering into subcooling core 10. As a result, the cooling ability of condenser 1 may be greatly increased.

[0045] Fig. 7 depicts the cross section of a header pipe portion of a heat exchanger according to a third embodiment of the present invention. In this embodiment, opening 19 of desiccant container 18 is directed so as to face the tube insertion side. However, the position of opening 19 is not limited to this embodiment, and opening 19 may be disposed within a region having an angle of circumference of 180 degrees at the tube insertion side as shown in Fig. 7. When opening 19 is disposed within this region, because the amount of refrigerant, coinciding with the outer surface of desiccant container 18 after entering from heat transfer tubes 4 into header pipe 3, becomes very small, the pressure loss may be decreased.

[0046] Thus, in this embodiment, since opening is disposed so as to face the tube insertion side, refrigerant discharged from heat transfer tubes 4 flows substantially directly into desiccant container 18 through opening 19. Namely, as shown by arrows in Fig. 7, without collision with the outer surface of desiccant container 18, and without forming a bypass flow between the outer surface of desiccant container 18 and the inner surface of header pipe 3, the refrigerant enters into desiccant container 18 at a condition of the shortest passage. Therefore, the pressure loss may be greatly decreased. Further, also in liquid storing portion 11, liquid refrigerant flows directly into heat transfer tubes 4 forming subcooling core 10 at a similar condition of the shortest passage, the pressure loss at this portion may also be decreased greatly.

[0047] Figs. 8 to 12 depict a fourth embodiment of the present invention. Desiccant container 18 is inserted through insertion holes 22 and 23 of annular support members 15 and 16, and the outer surface of desiccant container 18 is brazed to the inner surfaces of insertion holes 22 and 23 of support members 15 and 16. The diameters of insertion holes 22 and 23 are set at a size equal to or slightly smaller than the outer diameter of desiccant container 18 which is in its free state. Support members 15 and 16 are brazed to the inner surface of header pipe 3. Sector-shaped notches 24 and 25 are defined on support members 15 and 16. In this embodiment, the opening size of notches 24 and 25 is set at about the same size as opening size Cr of opening 19 of desiccant container 18. Slits 26 and 27 for insertion of support members 15 and 16 into header pipe 3 are

defined on header pipe 3, as depicted in Figs. 11 and 12.

[0048] In this embodiment, because desiccant container 18 has opening 19 continuously extending in the longitudinal direction, when the desiccant container 18 is inserted into header pipe 3, the diameter of the desiccant container 18 may be decreased by its elastic deformation as compared with the diameter at its free state. Therefore, desiccant container 18 may be easily inserted even into insertion holes 22 and 23 which have a diameter equal to or slightly smaller than the free-state diameter of desiccant container 18. After desiccant container 18 is inserted through insertion holes 22 and 23, because the diameter of desiccant container 18 returns to the initial diameter that is a diameter at free state, the outer surface of desiccant container 18 comes into contact with the inner surface of insertion holes 22 and 23, and desiccant container 18 may be securely fixed at a proper position in header pipe 3 via support members 15 and 16. Moreover, when all parts are brazed in a furnace at that state, desiccant container 18 may be brazed to support members 15 and 16 at a proper position with a high accuracy. In such a condition, even in a case where condenser 1 is used for an air conditioner for vehicles, occurrence of the vibration of desiccant container 18 in header pipe 3 may be suppressed or prevented, and generation of noise or foreign materials by the vibration may be prevented.

[0049] Although desiccant container 18 is brazed to support members 15 and 16 in this embodiment, after insertion of desiccant container 18 into insertion holes 22 and 23 of support members 15 and 16, the desiccant container 18 may be connected to support members 15 and 16 by enlarging the diameter of desiccant container 18 using a jig and the like.

[0050] Further, although desiccant container 18 made of a metal is brazed to support members 15 and 16 in this embodiment, it is possible to fix desiccant container 18 to support members 15 and 16 strongly and securely only by the elastic recovery force of desiccant container 18 in the direction for enlarging the diameter of desiccant container 18, as described above. Therefore, it is possible to make desiccant container 18 from a resin.

[0051] Further, since notches 24 and 25 are provided on support members 15 and 16 in this embodiment, refrigerant in header pipe 3 may easily flow downward in header pipe 3 by passing through notches 24 and 25. Therefore, the pressure loss in header pipe 3 may be suppressed small. However, the support structure is not limited to this embodiment. It is possible to employ a structure wherein notches are not provided to support members 15 and 16, the support members 15 and 16 are formed as complete annular members, and desiccant container 18 is inserted into and fixed to the annular support members 15 and 16.

[0052] Furthermore, in this embodiment, since slits 26 and 27 extending in a circumferential direction for inserting support members 15 and 16 are provided on header pipe 3 as shown in Figs. 11 and 12, it becomes possible to insert support members 15 and 16 into header pipe 3 through slits 26 and 27 to complete a temporary assembly condition and thereafter braze the support members 15 and 16 in a furnace together with other parts. Therefore, in this embodiment, the workability for assembly of heat exchanger 1 including the assembly of support members 15 and 16 may be increased. Although desiccant container 18 is fixed to support members 15 and 16 in this embodiment, another structure may be employed. For example, a fitting recess may be provided on lid 21 instead of support member 15, and the end portion of desiccant container 18 may be fitted into and fixed to the recess.

Claims

1. A heat exchanger including a pair of header pipes, a plurality of heat transfer tubes interconnecting said pair of header pipes and extending in parallel to each other, and a desiccant container containing a desiccant inserted into at least one of said pair of header pipes, **characterized in that** said desiccant container comprises a tubular body having an opening which extends continuously in the longitudinal direction of said tubular body over the entire length of said tubular body.

2. The heat exchanger according to claim 1, wherein said desiccant container has a C-shaped cross section.

3. The heat exchanger according to claim 1 or 2, wherein said opening has an angle of circumference in the cross section of said desiccant container in a range of 10 degrees to 90 degrees.

4. The heat exchanger according to any preceding claim, wherein said opening is disposed so that a fluid, discharged from said heat transfer tubes into said at least one of said pair of header pipes, flows into said desiccant container through said opening after the fluid flows between an outer surface of said desiccant container and an inner surface of said at least one of said pair of header pipes.

5. The heat exchanger according to claim 4, wherein said opening is disposed within a region having an angle of circumference of 270 degrees at a side opposite to a side inserted with said heat transfer tubes into said at least one of said pair of header pipes.

6. The heat exchanger according to any of claims 1 to 3, wherein said opening is disposed at a side inserted with said heat transfer tubes into said at least one of said pair of header pipes.

7. The heat exchanger according to claim 6, wherein said opening is disposed within a region having an angle of circumference of 180 degrees at said side inserted with said heat transfer tubes into said at least one of said pair of header pipes.

8. The heat exchanger according to any preceding claim, wherein an annular support member having an insertion hole inserted with said desiccant container is provided in said at least one of said pair of header pipes, and said desiccant container is fixed to an inner circumferential surface of said insertion hole of said support member.

9. The heat exchanger according to claim 8, wherein said desiccant container is fixed to said support member by brazing.

10. The heat exchanger according to claim 8, wherein said desiccant container is fixed to said support member by enlarging a diameter of said desiccant container.

11. The heat exchanger according to any of claims 8 to 10, wherein a notch is provided to said support member.

12. The heat exchanger according to any of claims 8 to 11, wherein said at least one of said pair of header pipes has a slit extending in the circumferential direction of said at least one of said pair of header pipes for inserting said support member into said at least one of said pair of header pipes.

13. The heat exchanger according to any preceding claim, wherein said desiccant container is made of a resin.

14. The heat exchanger according to any of claims 1 to 12, wherein said desiccant container is made of a metal.

15. The heat exchanger according to any preceding claim, wherein said heat exchanger is formed as a subcooling-type condenser which comprises a refrigerant condensation core for condensing refrigerant and a subcooling core for supercooling refrigerant condensed by said refrigerant condensation core.

FIG. 1

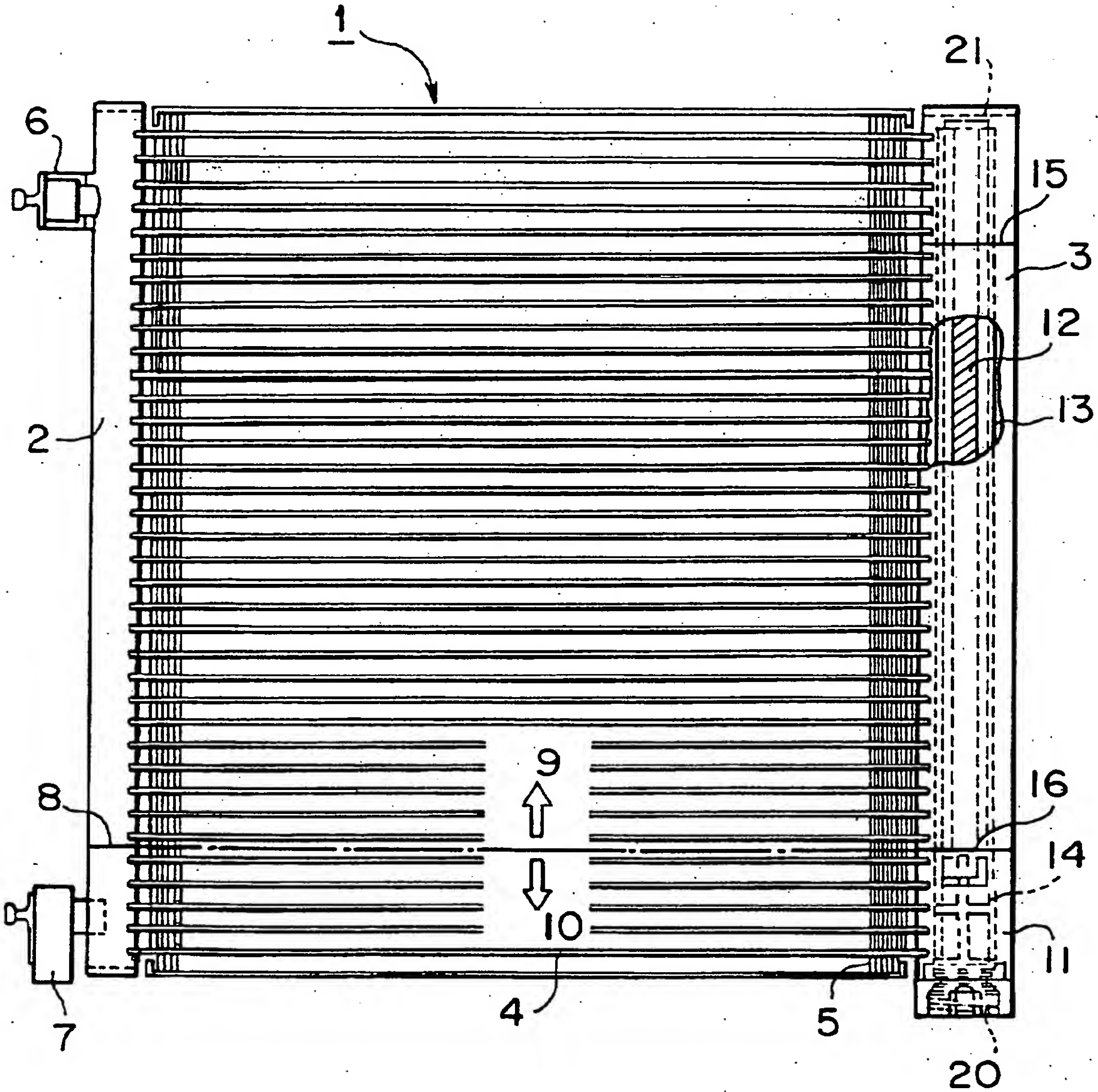


FIG. 2

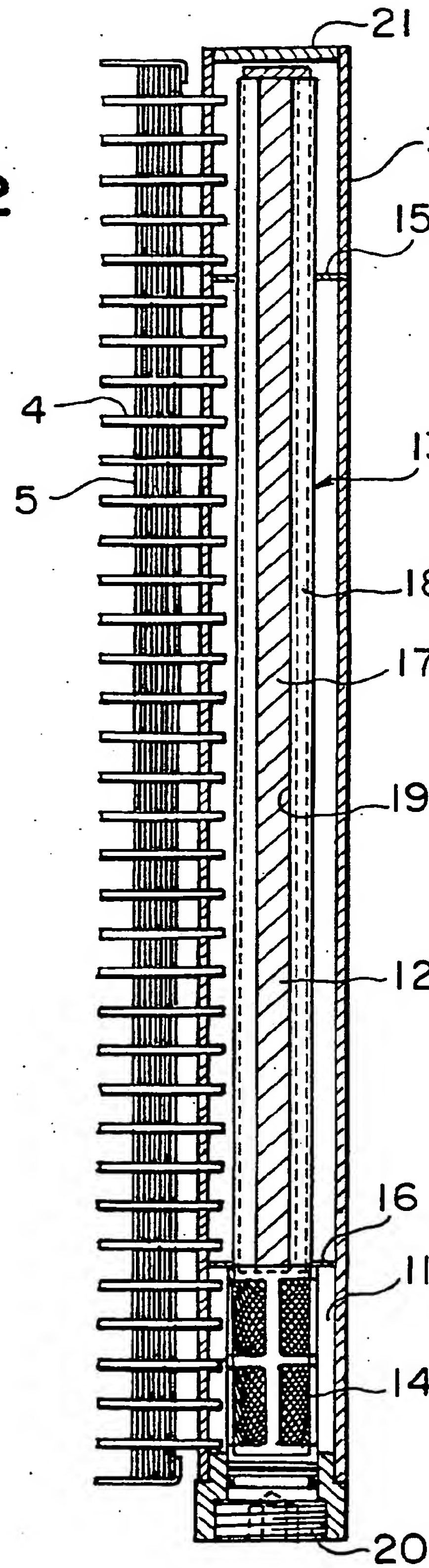


FIG. 3

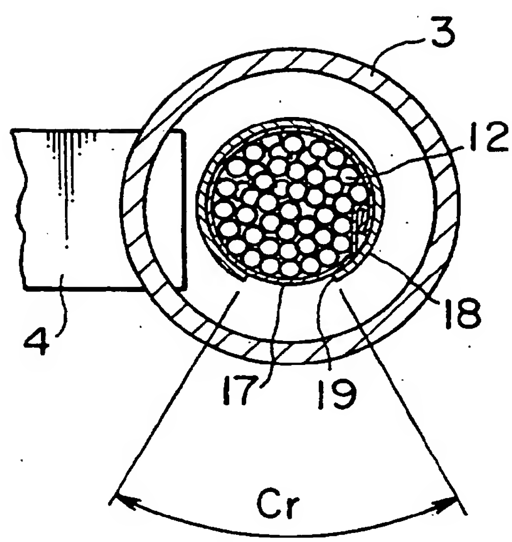


FIG. 4

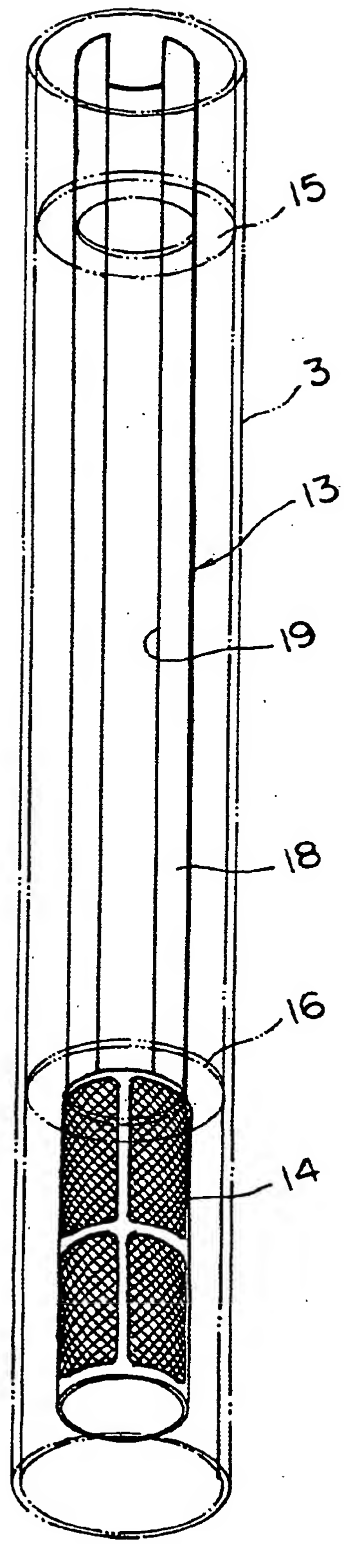


FIG. 5

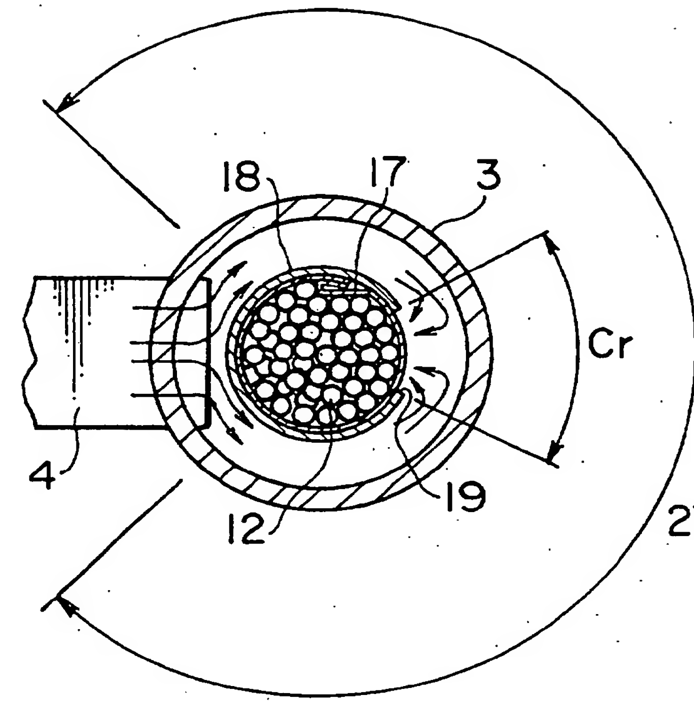


FIG. 6

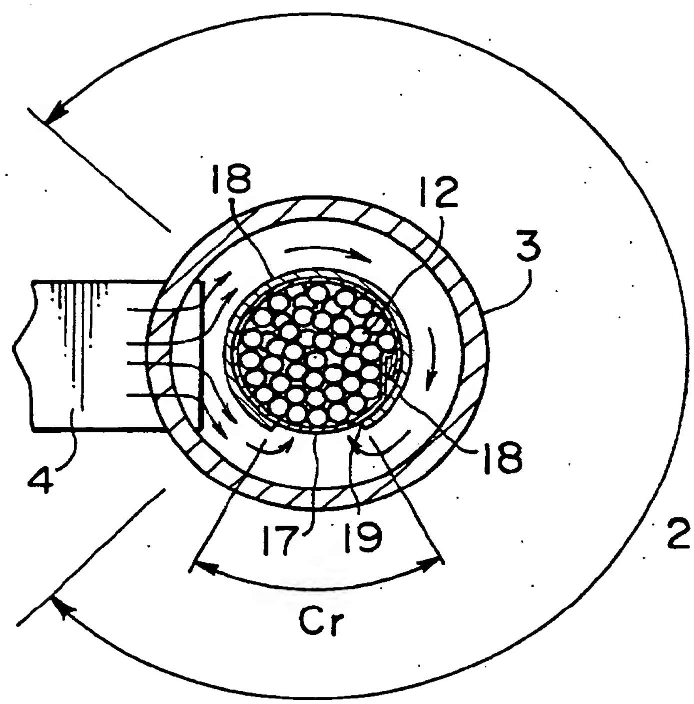


FIG. 7

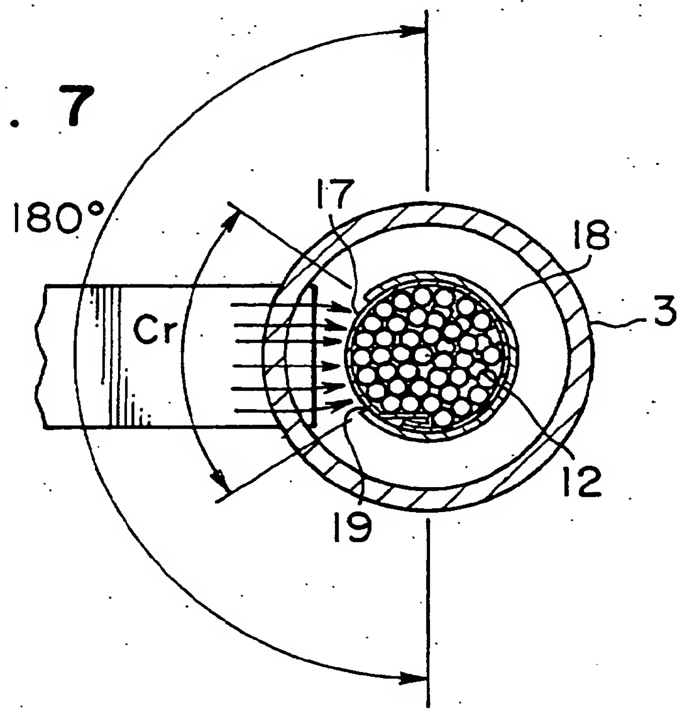


FIG. 8

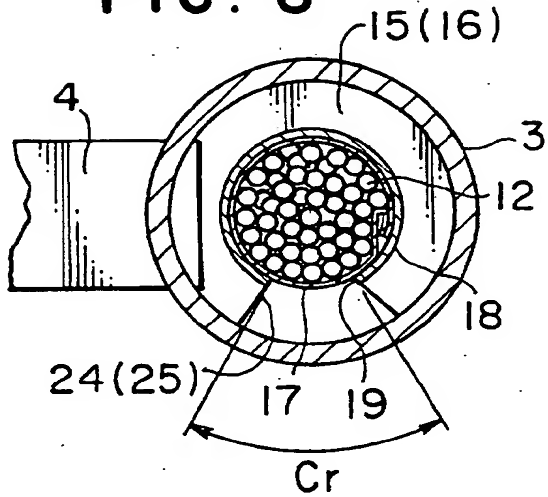


FIG. 9

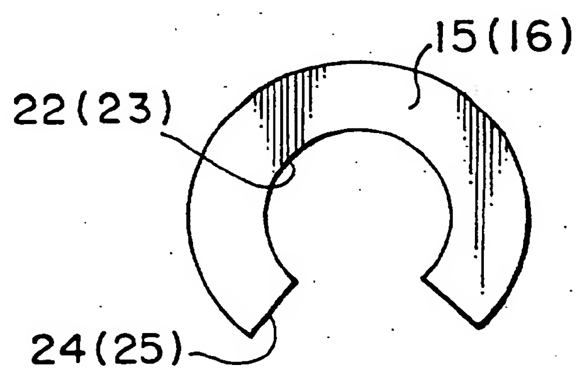


FIG. 10

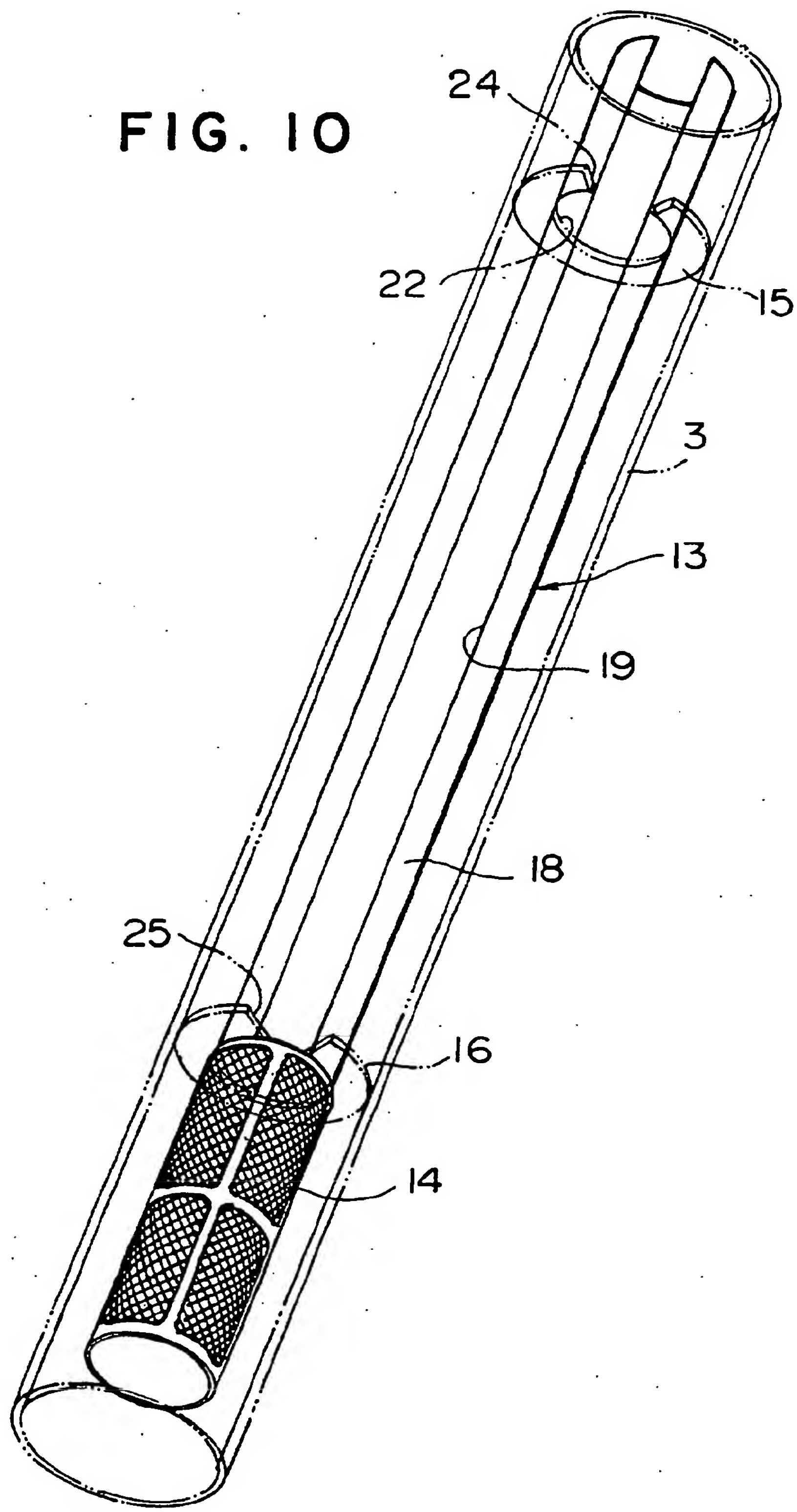


FIG. 11

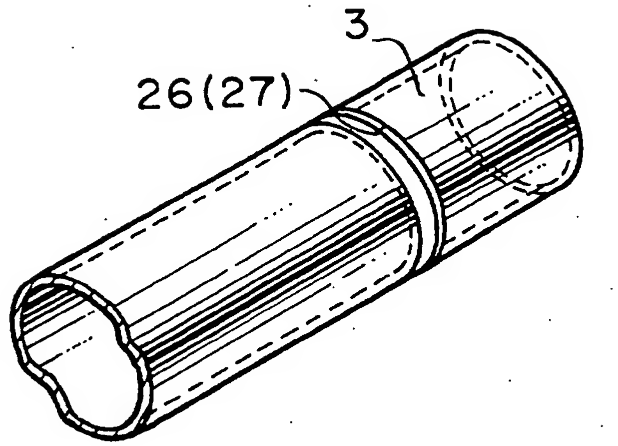


FIG. 12

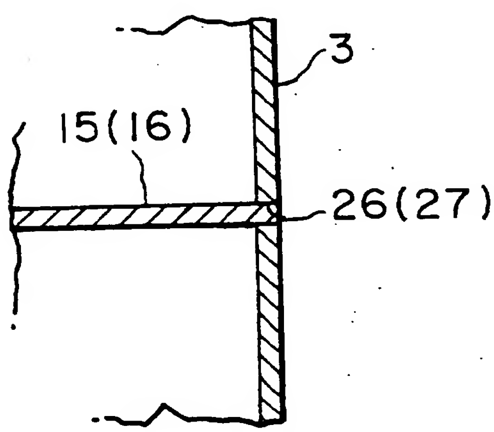


FIG. 13

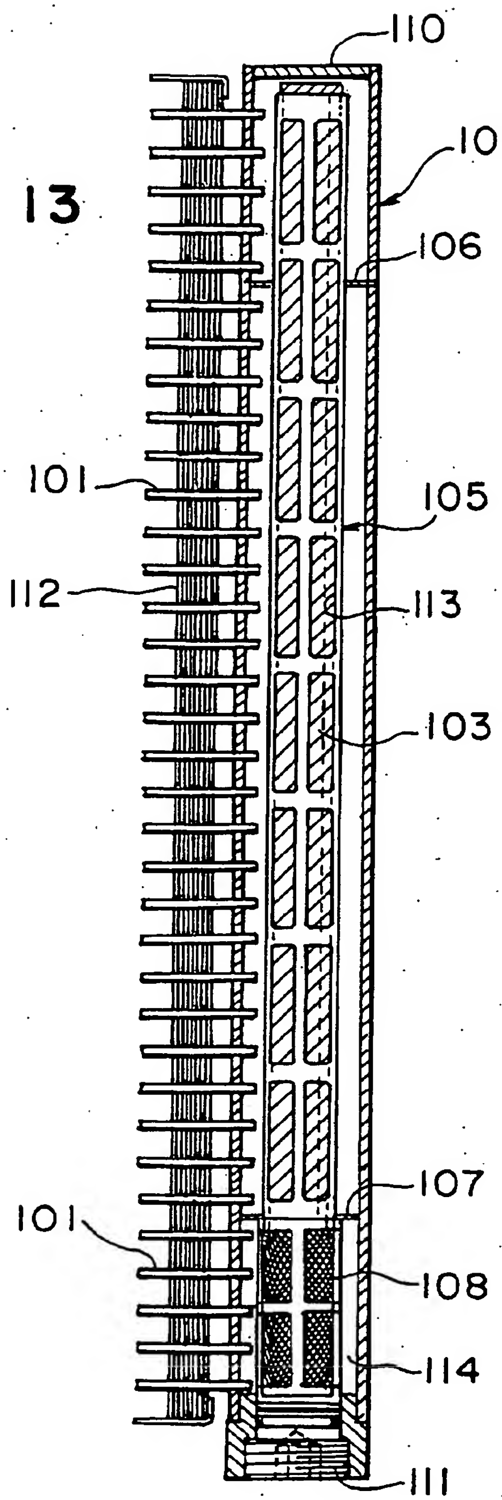


FIG. 14

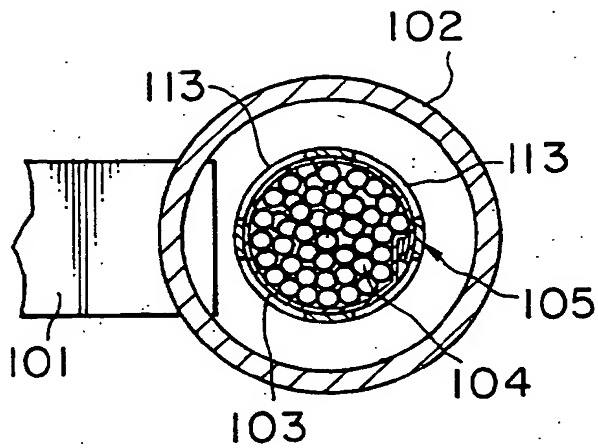


FIG. 15

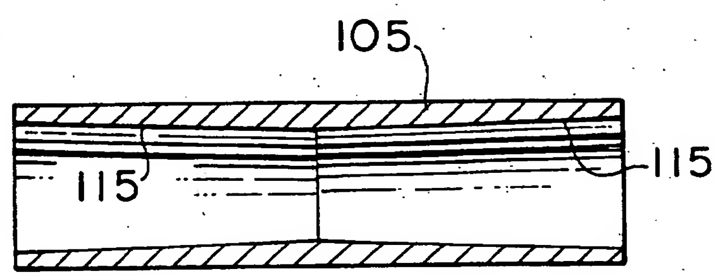
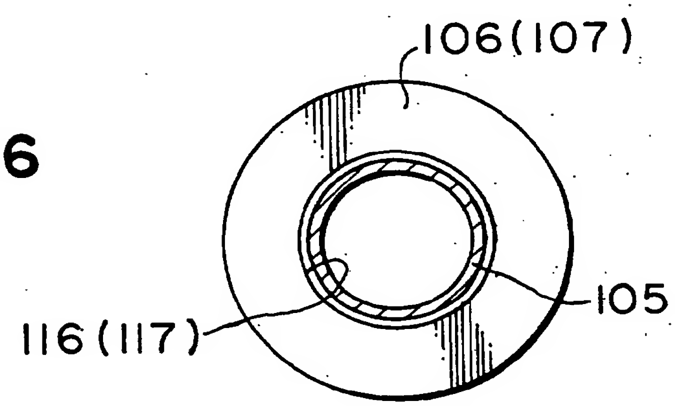


FIG. 16



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 25 8268

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 419 141 A (BURK ROLAND) 30 May 1995 (1995-05-30) * abstract * * column 2, line 19 - column 3, line 24 * * figures 1,2 *	1	F25B39/04 F25B43/00 F28F9/02
A	FR 2 750 761 A (VALEO THERMIQUE MOTEUR) 9 January 1998 (1998-01-09) * abstract * * figures 1-3 *	1	
A	EP 0 669 506 A (BEHR GMBH & CO) 30 August 1995 (1995-08-30)		
A	US 6 158 503 A (GILLE GERARD ET AL) 12 December 2000 (2000-12-12)		

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 April 2003	De Graaf, J.D.

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